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EXAMINER	
GUILL, RUSSELL L	
ART UNIT	PAPER NUMBER
2123	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/27/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/099,721	Applicant(s) JAMES, GREGORY E.
	Examiner Russ Guill	Art Unit 2123

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 January 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4,5 and 7-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4,5 and 7-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 March 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *6/19/2002*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

1. This non-final Office Action is in response to an Amendment filed January 17, 2007. No claims were added. Claims 3 and 6 were canceled. Claims 1 - 2, 4 - 5 and 7 - 31 are pending. 1 - 2, 4 - 5 and 7 - 31 have been examined. Claims 1 - 2, 4 - 5 and 7 - 31 have been rejected.

2. **Following review with senior examination staff in the graphics processor art, this Office Action is NON-final due to new rejections, and new rejections under 35 USC § 101.**

3. The indicated allowability of claim 11 is withdrawn in view of the newly cited reference(s) in Rumpf (Martin Rumpf et al.; "Using Graphics Cards for Quantized FEM Computations", September 3 - 5 2001, Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing). Rejections based on the newly cited reference(s) follow.

Response to Remarks

4. Regarding the Information Disclosure Statement (IDS) filed June 11, 2002:

   a. The IDS was considered in the previous Office Action dated June 16, 2006, and the signed IDS appears to be correctly recorded as a document code 1449 entry in the electronic file wrapper (dated June 16, 2006). Both applications recited in the IDS have issued as patents. The IDS appears to be dated June 19, 2002.

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

6. **Claims 1 - 2, 4 - 5 and 7 - 31** are rejected under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter.

a. Regarding **claims 1 - 2, 4 - 5 and 7 - 31**, the claims do not appear to produce a tangible result to form the basis of a practical application needed to be statutory. The claims all appear to include abstract ideas such as generating a solution to a partial differential equation. Therefore, in order to be statutory, the claims must be directed to a practical application having a useful, concrete and tangible result (or perform a physical transformation). Generating output for display does not appear to produce a tangible result, since the output is not actually displayed. Further, enhancing graphics processing operations does not appear to produce a tangible result. Further, rendering does not appear to necessarily produce a tangible result.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Regarding all **claims 1 - 2, 4 - 5 and 7 - 31**, the art of Rumpf teaches using a graphics hardware pipeline to solve partial differential equations. After the inventive step of Rumpf, implementing any known method of solving a partial differential equation using a hardware graphics pipeline would have been obvious. The ordinary artisan would have known to turn to references describing solution methods to partial differential equations both by the nature of the problem and the benefit of saving time and cost by using proven previous solution methods. Further, since a graphics pipeline performs numeric calculation, it is inherent in the device that it can be used to solve a partial differential equation (see MPEP section 2112).

9. **Claims 1 - 2, 12 - 18, 22 - 23 and 27** are rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in Fortran 77", 2001, Second edition, Cambridge University Press) in view of Rumpf (Martin

Rumpf et al.; "Using Graphics Cards for Quantized FEM Computations", September 3 - 5 2001, Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing).

a. Regarding **claim 1**:

b. Press appears to teach:

i. Receiving input (**pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 855**);

ii. Processing the input to generate the solution to the partial differential equation (**pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems**);

c. Press does not specifically teach:

i. Receiving input *in the hardware graphics pipeline*;

ii. Processing the input to generate the solution to the partial differential equation *utilizing the hardware graphics pipeline*;

iii. *Generating output utilizing the hardware graphics pipeline for display*;

iv. *Wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline*.

v. *Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline*.

vi. *Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures*.

d. Rumpf appears to teach:

i. Receiving input in the hardware graphics pipeline (*third page, figure 1*);

ii. Processing the input to generate the solution to the partial differential equation utilizing the hardware graphics pipeline (*third page, section 3.1 Vector Representation, first paragraph; and seventh page, section 6. Linear Heat Equation, first paragraph*);

iii. Generating output utilizing the hardware graphics pipeline for display (*ninth page, figure 3*);

iv. Wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline (*seventh page, section 6. Linear Heat Equation, first paragraph*);

v. Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline (*ninth page, figure 3, displays surfaces and objects rendered by utilizing the solution to a partial differential equation utilizing a hardware graphics pipeline*).

vi. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures (*second and third pages, section 2. Computational Setting; and third page, figure 1*).

e. The motivation to use the art of Rumpf with the art of Press would have been the benefits recited in Rumpf that the presented strategy opens a wide area of numerical applications for hardware acceleration (*first page, Abstract, first paragraph*), and turns a graphics card into an ultrafast vector coprocessor (*first page, Abstract, first paragraph*), which would have been recognized by the ordinary artisan as benefits that allow faster processing.

f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Rumpf with the art of Press to produce the claimed invention.

===

g. Regarding **claim 2**:

h. Press appears to teach:

i. Input represents boundary conditions (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems);

==

i. Regarding **claim 12**:

j. Press appears to teach:

   i. The processing includes a relaxation operation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that processing includes a relaxation operation, especially since the title of the section recites Relaxation Methods);

==

k. Regarding **claim 13**:

l. Press appears to teach:

   i. The relaxation operation is selected based on the partial differential equation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that the relaxation operation is selected based on the partial differential equation, especially since such an example is presented);

==

m. Regarding **claim 14**:

n. Press appears to teach:

   i. The processing includes a plurality of iterations of the relaxation operation (pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; especially references to Gauss-Seidel method and Jacobi's method);

==

o. Regarding **claim 15**:

p. Press appears to teach:

   i. A number of iterations of the relaxation operation is reduced using at least one of a prolongation operation and a restriction operation (pages 862-868, section 19.6

Multigrid Methods for Boundary Value Problems, especially page 865 Smoothing, Restriction and Prolongation Operators);

==

q. Regarding **claim 16**:

r. Press appears to teach:

i. The processing further includes determining whether the solution has converged (pages 855, Relaxation Methods for Boundary Value Problems; second paragraph, section that starts with "Thus the algorithm consists . . .", sentence, "This procedure is then iterated until convergence.");

==

s. Regarding **claim 17**:

t. Press appears to teach:

i. It is determined whether the solution has converged after each iteration of the relaxation operation (pages 855, Relaxation Methods for Boundary Value Problems; second paragraph, section that starts with "Thus the algorithm consists . . .", sentence, "This procedure is then iterated until convergence.");

==

u. Regarding **claim 18**:

v. Press appears to teach:

i. It is determined whether the solution has converged after a predetermined number of multiple iterations of the relaxation operation (pages 855, Relaxation Methods for Boundary Value Problems; second paragraph, section that starts with "Thus the algorithm consists . . .", sentence, "This procedure is then iterated until convergence.");

==

w. Regarding **claim 22**:

x. Press appears to teach:

i. If it is determined that the solution has converged repeating the processing using an altered parameter value operation (**pages 862-868, section 19.6 Multigrid Methods for Boundary Value Problems; it would have been obvious to altering a grid size is altering a parameter**);

==

y. Regarding **claim 23**:

z. Press appears to teach:

i. The number of iterations of the relaxation operation is determined prior to the processing (**pages 860, Relaxation Methods for Boundary Value Problems; code example with a parameter value MAXITS = 1000 and a loop DO N=1,MAXITS**);

==

aa. Regarding **claim 27**:

i. Claim 27 is taught as in claim 1 above.

==

10. **Claims 19 - 21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Press as modified by Rumpf as applied to claims **1 - 2, 12 - 18, 22 - 23 and 27** above, further in view of Roy-Chowdhury (Roy-Chowdhury, Amber; Bellas, Nikolas; Banerjee, Prithviraj; "Algorithm-Based Error-Detection Schemes for Iterative Solution of Partial Differential Equations", 1996, IEEE Transactions on Computers, Vol. 45, No. 4).

a. Press as modified by Rumpf teaches a hardware graphics pipeline implemented method for generating a solution to a partial differential equation in a hardware graphics pipeline.

b. Regarding **claim 19**:

c. Press does not specifically teach:

i. The determining whether the solution has converged includes calculating errors;

d. Roy-Chowdhury appears to teach:

i. The determining whether the solution has converged includes calculating errors (<u>page 400, left-side column, top-half</u>);

e. The motivation to use the art of Roy-Chowdhury with the art of Press as modified by Rumpf would have been the benefit recited in Roy-Chowdhury that the presented algorithm-based fault tolerance is an inexpensive method of achieving fault tolerance without requiring any hardware modifications, especially for iterative solution of linear systems arising from discretization of partial differential equations (<u>page 394, Abstract</u>).

f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Roy-Chowdhury with the art of Press as modified by Rumpf to produce the claimed invention.

==

g. Regarding **claim 20**:

h. Press does not specifically teach:

i. The determining whether the solution has converged further includes summing the errors;

i. Roy-Chowdhury appears to teach:

i. The determining whether the solution has converged further includes summing the errors (<u>page 400, left-side column, top-half</u>);

==

j. Regarding **claim 21**:

k. Press does not specifically teach:

i. Concluding that the solution has converged if the error is less than a predetermined amount;

l. Roy-Chowdhury appears to teach:

i. Concluding that the solution has converged if the error is less than a predetermined amount (<u>page 400, left-side column, top-half</u>);

==

11. **Claims 4 - 5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Press as modified by Rumpf as applied to claims **1 - 2, 12 - 18, 22 - 23 and 27** above, further in view of Weiskopf (Weiskopf, Daniel; Hopf, Matthias; Ertl, Thomas; "Hardware-Accelerated Visualization of Time-Varying 2D and 3D Vector Fields by Texture Advection via Programmable Per-Pixel Operations", 2001, Proceedings of the Vision Modeling and Visualization Conference 2001).

a. Press as modified by Rumpf teaches a hardware graphics pipeline implemented method for generating a solution to a partial differential equation in a hardware graphics pipeline.

b. Regarding **claim 4**:

c. Press does not specifically teach:

i. the input includes geometry;

d. Weiskopf appears to teach:

i. the input includes geometry (**<u>pages 668 - 669, section 3 Hardware-Based 2D Texture Advection; it would have been obvious that the input includes geometry; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved</u>**);

==

e. Regarding **claim 5**:

f. Press does not specifically teach:

i. the geometry is selected from the group consisting of polygons, vertex data, points, and lines;

g. Weiskopf appears to teach:

i. the geometry includes points (pages 668 - 669, section 3 Hardware-Based 2D Texture Advection; it would have been obvious that the input includes geometry; please note that the partial differential equation on page 667, right-side column, second paragraph, is being solved);

==

12. **Claims 7 - 9 and 24 - 25** are rejected under 35 U.S.C. 103(a) as being unpatentable over Press as modified by Rumpf and Weiskopf as applied to claims **3 - 6** above, further in view of Ewins (Ewins, Jon P.; Waller, Marcus D.; White, Martin; Lister, Paul F.; "MIP-Map Level Selection for Texture Mapping", 1998, IEEE Transactions on Visualization and Computer Graphics, Vol. 4, No. 4).

a. Press as modified by Rumpf and Weiskopf teaches a hardware graphics pipeline implemented method for generating a solution to a partial differential equation in a hardware graphics pipeline.

b. Regarding **claim 7**:

c. Press does not specifically teach:

i. the local area of textures is generated by sampling a texture map;

d. Ewins appears to teach:

i. sampling a texture map (pages 318 - 319, section 1.1 Texture Filtering);

e. The motivation to use the art of Ewins with the art of Press as modified by Rumpf and Weiskopf would have been the benefit recited in Ewins that texture mapping allows a high degree of visual complexity without the expense of overly complex geometric modeling (page 317, section 1 Introduction, and Abstract).

f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Ewins with the art of Press as modified by Rumpf and Weiskopf to produce the claimed invention.

==

g. Regarding **claim 8**:

h. Press does not specifically teach:

i. the local area of textures is filtered;

i. Ewins appears to teach:

    i. the local area of textures is filtered (<u>**pages 318 - 319, section 1.1 Texture Filtering**</u>);

==

j. Regarding **claim 9**:

k. Press does not specifically teach:

    i. the local area of textures is filtered utilizing a plurality of filters;

l. Ewins appears to teach:

    i. the local area of textures is filtered utilizing a plurality of filters (<u>**pages 318 - 319, section 1.1 Texture Filtering**</u>);

==

m. Regarding **claim 24**:

n. Press does not specifically teach:

    i. the filtering is carried out using a programmable filter;

o. Ewins appears to teach:

    i. the filtering is carried out using a programmable filter (<u>**pages 318 - 319, section 1.1 Texture Filtering**</u>);

==

p. Regarding **claim 25**:

q. Press does not specifically teach:

    i. the filtering is carried out using a non-programmable filter;

r. Ewins appears to teach:

    i. the filtering is carried out using a non-programmable filter (<u>**pages 318 - 319, section 1.1 Texture Filtering**</u>);

==

13. **Claims 10 - 11** are rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in Fortran 77", 2001, Second edition, Cambridge University Press) in view of Rumpf (Martin Rumpf et al.; "Using Graphics Cards for Quantized FEM Computations", September 3 - 5 2001, Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing).

a. Regarding **claim 10**:

b. Press appears to teach:

i. Receiving input (**pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 855**);

ii. Processing the input to generate the solution to the partial differential equation (**pages 854-856, section 19.5 Relaxation Methods for Boundary Value Problems**);

c. Press does not specifically teach:

i. Receiving input *in the hardware graphics pipeline;*

ii. Processing the input to generate the solution to the partial differential equation *utilizing the hardware graphics pipeline;*

iii. Generating output utilizing the hardware graphics pipeline for display;

iv. *Wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline;*

v. *Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline;*

vi. *Wherein the input includes a local area of textures;*

vii. *Wherein the local area of textures is filtered utilizing a filter including a plurality of elements;*

viii. *Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures*.

d. Rumpf appears to teach:

i. Receiving input in the hardware graphics pipeline (***third page, figure 1***);

ii. Processing the input to generate the solution to the partial differential equation utilizing the hardware graphics pipeline (***third page, section 3.1 Vector Representation, first paragraph; and seventh page, section 6. Linear Heat Equation, first paragraph***);

iii. Generating output utilizing the hardware graphics pipeline for display (***ninth page, figure 3***);

iv. Wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline (***seventh page, section 6. Linear Heat Equation, first paragraph***);

v. Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline (***ninth page, figure 3, displays surfaces and objects rendered by utilizing the solution to a partial differential equation utilizing a hardware graphics pipeline***).

vi. Wherein the input includes a local area of textures (***third page, figure 1; please note the textures input***);

vii. Wherein the local area of textures is filtered utilizing a filter including a plurality of elements (***seventh page, right-side column, second and third paragraphs; please note that a convolution operation is a filter operation***);

viii. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures (***second and third pages, section 2. Computational Setting; and third page, figure 1***).

e. The motivation to use the art of Rumpf with the art of Press would have been the benefits recited in Rumpf that the presented strategy opens a wide area of numerical applications for hardware acceleration (***first page, Abstract, first paragraph***), and turns a graphics card into an ultrafast vector coprocessor (***first page, Abstract, first paragraph***), which would have been recognized by the ordinary artisan as benefits that allow faster processing.

f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Rumpf with the art of Press to produce the claimed invention.

==

g. Regarding **claim 11**:

i. Claim 11 is taught as a subset of limitations as described in claim 10 above.

==

14. **Claims 26, 28 and 30 - 31** are rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in C", 1988, Cambridge University Press) in view of Rumpf (Martin Rumpf et al.; "Using Graphics Cards for Quantized FEM Computations", September 3 – 5 2001, Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing).

a. Regarding **claim 26**:

b. Press appears to teach:

i. Processing input (**<u>pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 673</u>**);

ii. Processing input to generate a solution to partial differential equations (**<u>pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems</u>**);

c. Press does not specifically teach:

i. *<u>A hardware graphics pipeline for</u>* processing input to generate a solution to partial differential equations *<u>wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline</u>*;

ii. *<u>Wherein the graphics processing operation performed by the hardware graphics pipeline is enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline</u>*;

iii. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures.

d. Rumpf appears to teach:

i. A hardware graphics pipeline for processing input to generate a solution to a partial differential equation wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline (***third page, section 3.1 Vector Representation, first paragraph; and seventh page, section 6. Linear Heat Equation, first paragraph***);

ii. Wherein the graphics processing operation performed by the hardware graphics pipeline is enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline (***ninth page, figure 3, displays surfaces and objects rendered by utilizing the solution to a partial differential equation utilizing a hardware graphics pipeline***);

iii. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures (***second and third pages, section 2. Computational Setting; and third page, figure 1***).

e. The motivation to use the art of Rumpf with the art of Press would have been the benefits recited in Rumpf that the presented strategy opens a wide area of numerical applications for hardware acceleration (***first page, Abstract, first paragraph***), and turns a graphics card into an ultrafast vector coprocessor (***first page, Abstract, first paragraph***), which would have been recognized by the ordinary artisan as benefits that allow faster processing.

f. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Rumpf with the art of Press to produce the claimed invention.

==

g. Regarding **claim 28**:

h. Press appears to teach:

i. Receiving boundary conditions (<u>**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems**</u>);

ii. Computing the solution to generate the solution to the partial differential equations involving the boundary conditions (<u>**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems**</u>);

iii. Determining whether the solution has converged (<u>**page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence."**</u>);

iv. If the solution has not converged, repeating the computing and determining (<u>**page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence."**</u>);

v. wherein the solution to the partial differential equation is generated (<u>**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems**</u>);

i. Press does not specifically teach:

i. Computing the solution to the partial differential equations involving the boundary conditions <u>*at least some of the computing done in the hardware graphics pipeline*</u>;

ii. <u>*Generating output utilizing the hardware graphics pipeline for display*</u>;

iii. wherein the solution to the partial differential equation is generated <u>*utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline*</u>;

iv. <u>*Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline*</u>;

v. <u>*Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures*</u> ;

j. Rumpf appears to teach:

i. Receiving input in the hardware graphics pipeline (<u>*third page, figure 1*</u>);

ii. Computing the solution to the partial differential equations at least some of the computing done in the hardware graphics pipeline wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline (*third page, section 3.1 Vector Representation, first paragraph; and seventh page, section 6. Linear Heat Equation, first paragraph*);

iii. Generating output utilizing the hardware graphics pipeline for display (*ninth page, figure 3*);

iv. Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline (*ninth page, figure 3, displays surfaces and objects rendered by utilizing the solution to a partial differential equation utilizing a hardware graphics pipeline*);

v. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures (*second and third pages, section 2. Computational Setting; and third page, figure 1*).

k. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Rumpf with the art of Press to produce the claimed invention.

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l. Regarding **claim 30**:

m. Press appears to teach:

i. Receiving a first input (**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that input is required to solve a partial differential equation, especially given the statement that an initial distribution relaxes to an equilibrium distribution on page 673**);

ii. Processing the first input to generate a solution to a partial differential equation (**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems**);

iii. wherein the solution to the partial differential equation is generated (**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems**);

n. Press does not specifically teach:

i. Receiving a first input *into a hardware graphics pipeline*;

ii. Processing the first input to generate a solution to a partial differential equation *utilizing the hardware graphics pipeline*;

iii. Receiving a second input into the hardware graphics pipeline;

iv. Rendering the 3D graphics image utilizing the hardware graphics pipeline for display, wherein the rendering utilizes the second input and the result of the processing of the first input;

v. wherein the solution to the partial differential equation is *generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline*;

vi. *Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline*;

vii. *Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures*.

o. Rumpf appears to teach:

i. Receiving a first input into a hardware graphics pipeline (*third page, figure 1*);

ii. Processing the first input to generate a solution to a partial differential equation utilizing the hardware graphics pipeline (*eighth page, left-side column, second paragraph; please note that an initial noisy image is input*);

iii. Receiving a second input into the hardware graphics pipeline (*eighth page, left-side column, second paragraph; please note that a contrast enhancing function is input*);

iv. Rendering the 3D graphics image utilizing the hardware graphics pipeline for display, wherein the rendering utilizes the second input and the result of the processing of the first input (*ninth page, figure 3*);

v. wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline (*seventh, eighth and ninth pages, section 7 Anisotropic Diffusion in Image Processing*);

vi. Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline (*ninth page, figure 3, displays surfaces and objects rendered by utilizing the solution to a partial differential equation utilizing a hardware graphics pipeline*);

vii. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures (*second and third pages, section 2. Computational Setting; and third page, figure 1*).

p. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Rumpf with the art of Press to produce the claimed invention.

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q. Regarding **claim 31**:

r. Press appears to teach:

i. The first input comprises boundary conditions (**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems**);

ii. determining whether the solution has converged (**page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence."**);

iii. If the solution has not converged, repeating the computing and determining (**page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence."**);

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15. **Claim 29** is rejected under 35 U.S.C. 103(a) as being unpatentable over Press (Press, William H.; Flannery, Brian P.; Teukolsky, Saul A.; Vetterling, William T.; "Numerical Recipes in C", 1988, Cambridge University Press), further in view of Roy-Chowdhury (Roy-Chowdhury, Amber; Bellas, Nikolas; Banerjee, Prithviraj; "Algorithm-Based Error-Detection Schemes for Iterative Solution of Partial Differential Equations",1996, IEEE Transactions on Computers, Vol. 45, No. 4) further in view of Rumpf (Martin Rumpf et al.; "Using Graphics Cards for Quantized FEM Computations", September 3 - 5 2001, Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing).

a. Regarding **claim 29**:

b. Press appears to teach:

i. Receiving boundary conditions (**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems; it would have been obvious that boundary conditions are required to solve a partial differential equation, especially since the title of the section recites Boundary Value problems**);

ii. computing the solution to the partial differential equation utilizing a relaxation operation involving the boundary conditions (pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems);

iii. determining whether the solution has converged (**page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence."**);

iv. If the solution has not converged, repeating the computing and determining (**page 674, first paragraph, subsection that starts with "Thus the algorithm . . .", sentence, "This procedure is then iterated until convergence."**);

v. if the solution has converged, incrementing a time value (**page 658, second paragraph, sentence that starts, "To solve equation (17.2.8) . . ."**); and

vi. repeating the foregoing operations using the incremented time value (**page 658, second paragraph, sentence that starts, "To solve equation (17.2.8) . . ."**).

vii. wherein the solution to the partial differential equation is generated conditions (**pages 673-676, section 17.5 Relaxation Methods for Boundary Value Problems**);

c. Press does not specifically teach:

i. Receiving boundary conditions *in the form of at least one of geometry and textures;*

ii. computing the solution to the partial differential equation utilizing a relaxation operation involving the boundary conditions *at least some of the computing done in the hardware graphics pipeline;*

iii. determining whether the solution has converged by:

(1) calculating the errors,

(2) summing the errors, and

iv. concluding that the solution has converged if the sum of errors is less than a predetermined amount;

v. *Generating output utilizing the hardware graphics pipeline for display;*

vi. wherein the solution to the partial differential equation is generated *utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by the hardware graphics pipeline;*

vii. *Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline;*

viii. *Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures.*

d. Roy-Chowdhury appears to teach:

i. determining whether the solution has converged by:

(1) calculating the errors (page 400, left-side column, top-half),

(2) summing the errors (page 400, left-side column, top-half),, and

ii. concluding that the solution has converged if the sum of errors is less than a predetermined amount (page 400, left-side column, top-half);

e. Rumpf appears to teach:

i. Receiving boundary conditions in the form of at least one of geometry and textures (*third page, figure 1*);

ii. wherein the solution to the partial differential equation is generated utilizing the hardware graphics pipeline for enhancing graphics processing operations performed by

the hardware graphics pipeline (*seventh page, section 6. Linear Heat Equation, first paragraph*);

iii. Wherein the graphics processing operations performed by the hardware graphics pipeline are enhanced by determining a location of surfaces or objects for rendering purposes utilizing the solution to the partial differential equation generated utilizing the hardware graphics pipeline (*ninth page, figure 3, displays surfaces and objects rendered by utilizing the solution to a partial differential equation utilizing a hardware graphics pipeline*).

iv. Generating output utilizing the hardware graphics pipeline for display (*ninth page, figure 3*);

v. Wherein the input includes a local area of textures used to sample a texture map to generate a modified local area of textures (*second and third pages, section 2. Computational Setting; and third page, figure 1*).

f. The motivation to use the art of Roy-Chowdhury with the art of Press would have been the benefit recited in Roy-Chowdhury that the presented algorithm-based fault tolerance is an inexpensive method of achieving fault tolerance without requiring any hardware modifications, especially for iterative solution of linear systems arising from discretization of partial differential equations (page 394, Abstract).

g. The motivation to use the art of Rumpf with the art of Press would have been the benefits recited in Rumpf that the presented strategy opens a wide area of numerical applications for hardware acceleration (*first page, Abstract, first paragraph*), and turns a graphics card into an ultrafast vector coprocessor (*first page, Abstract, first paragraph*), which would have been recognized by the ordinary artisan as benefits that allow faster processing.

h. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Roy-Chowdhury and the art of Rumpf with the art of Press to produce the claimed invention.

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16. **Examiner's Note:** Examiner has cited particular columns and line numbers in the references applied to the claims above for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the Applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner. **The entire body of all references are considered as being recited to teach the claimed invention**.

Conclusion

17. The prior art made of record and not relied upon is relevant to the Applicant's disclosure:
    a. Migdal (U.S. Patent 6,392,655) teaches local area of textures used to sample a texture map to generate a modified local area of textures.
    b. Fowler (U.S. Patent 20020180741) teaches local area of textures used to sample a texture map to generate a modified local area of textures.
    c. Morgan (U.S. Patent 6,756,989) teaches local area of textures used to sample a texture map to generate a modified local area of textures.
    d. Gossett (U.S. Patent 6,236,413) teaches multiple texture filters.
    e. Peterson (U.S. Patent Application Publication 20030028568) teaches texture filters.
    f. Lavelle (U.S. Patent Application Publication 20020171672) teaches texture filters.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Russ Guill whose telephone number is 571-272-7955. The examiner can normally be reached on Monday - Friday 10:00 AM - 6:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached on 571-272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Any inquiry of a general nature or relating to the status of this application should be directed to the TC2100 Group Receptionist: 571-272-2100.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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2/9/07